Modeling of sand deposition in archeologically significant reaches of the Colorado River in Grand Canyon

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Possible linkages between dam closure and gully development

Hereford, Fairley, Thompson, and Balsom –

1. Erosion of sand bars
2. Lowering of riverside base level
3. Persistent gully development

Possible linkages between dam closure and gully development

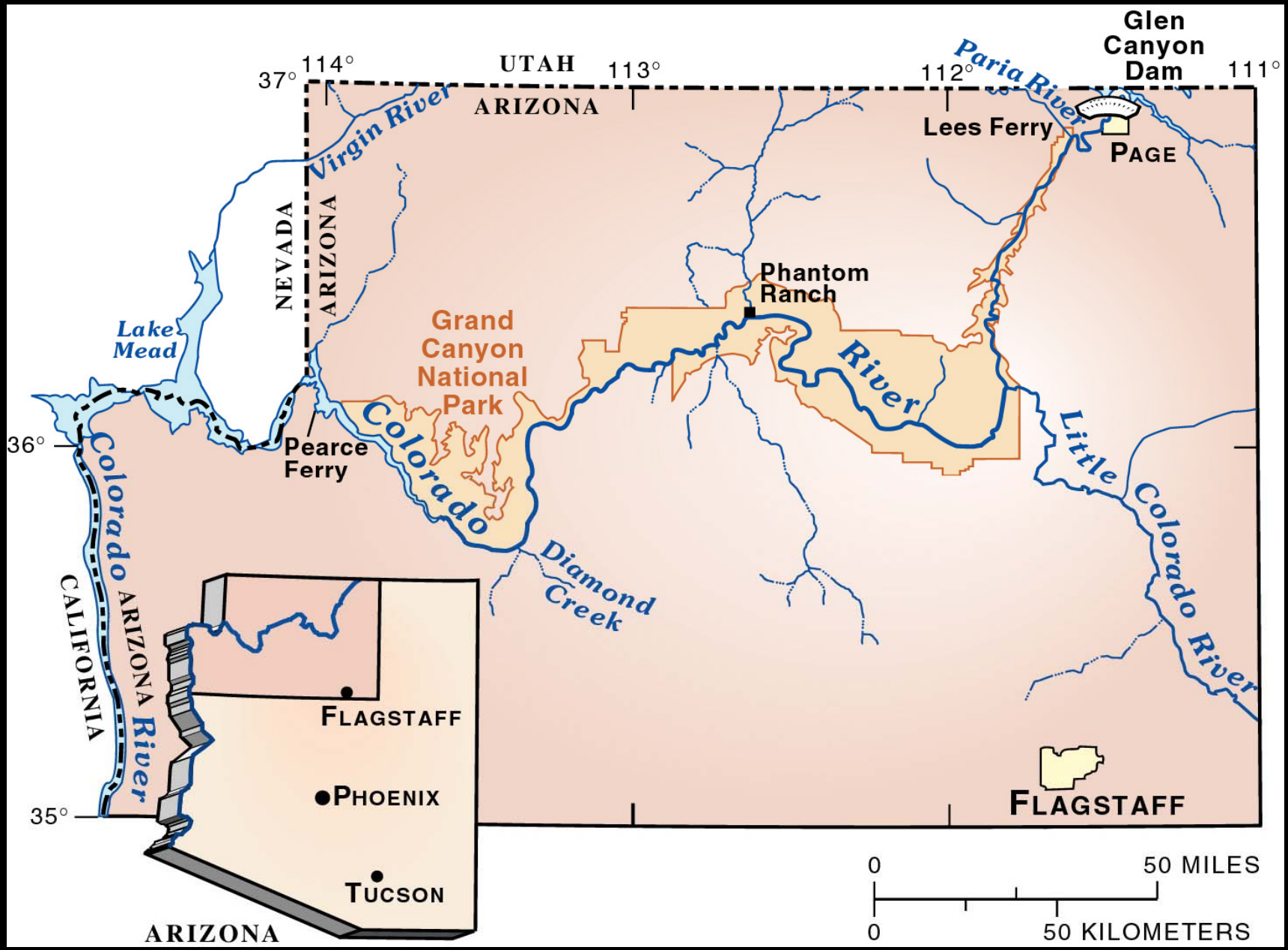
below Tanner

Eolian processes –

1. Erosions of sand bars
2. Diminished source for wind-blown sand
3. Incipient gullies no longer filled in

Cultural resources

How effective would high releases be in depositing sand in gullies in reaches with vulnerable artifacts?


Glen Canyon Dam
Paria River
37°
114°
UTAH
113°
112°
111°
ARIZONA
Virgin River
Lees Ferry
PAGE
NEVADA
ARIZONA
Phantom Ranch
Lake Mead
Grand Canyon National Park
Colorado River
Little Colorado River
36°
Pearce Ferry
Diamond Creek
Colorado River
ARIZONA
CALIFORNIA
FLAGSTAFF
PHOENIX
35°
TUCSON
ARIZONA
FLAGSTAFF
0
50 MILES
0
50 KILOMETERS

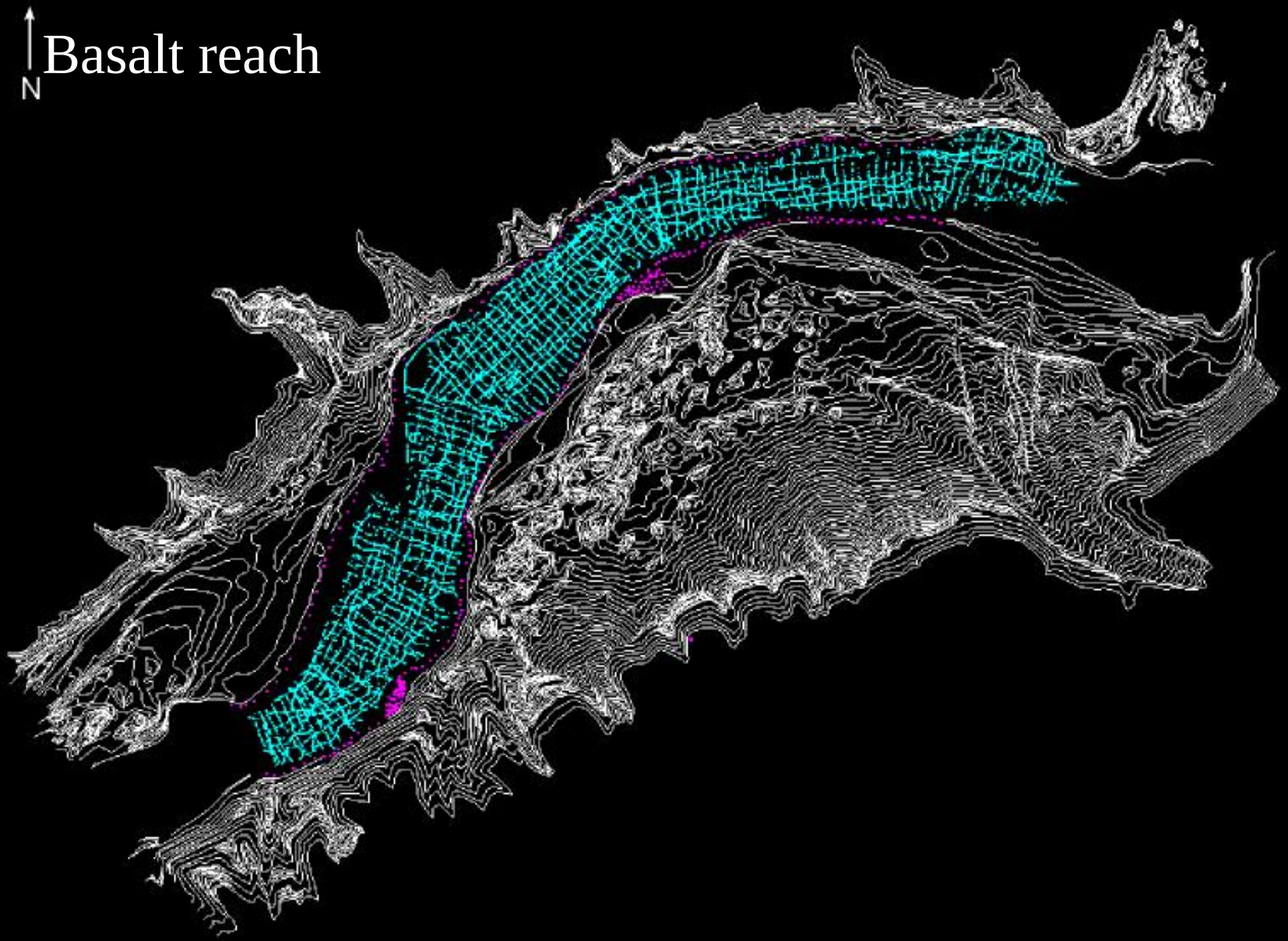
Model of flow, sand transport, and bed evolution

-- calculate vertically averaged flow field

-- calculate 3d suspended sand field

-- calculate local sand discharge

-- calculate change in bed elevation over a small time step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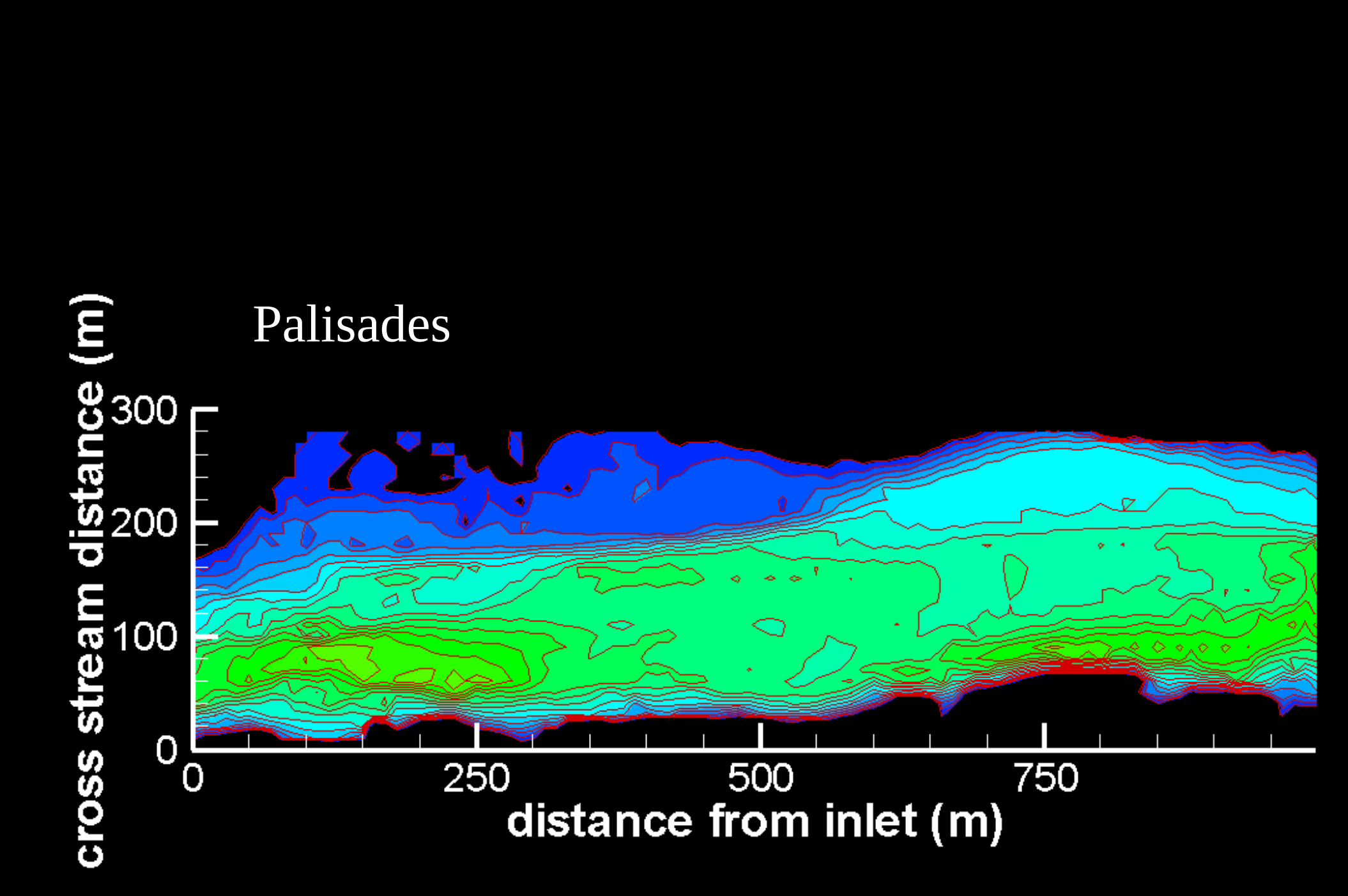
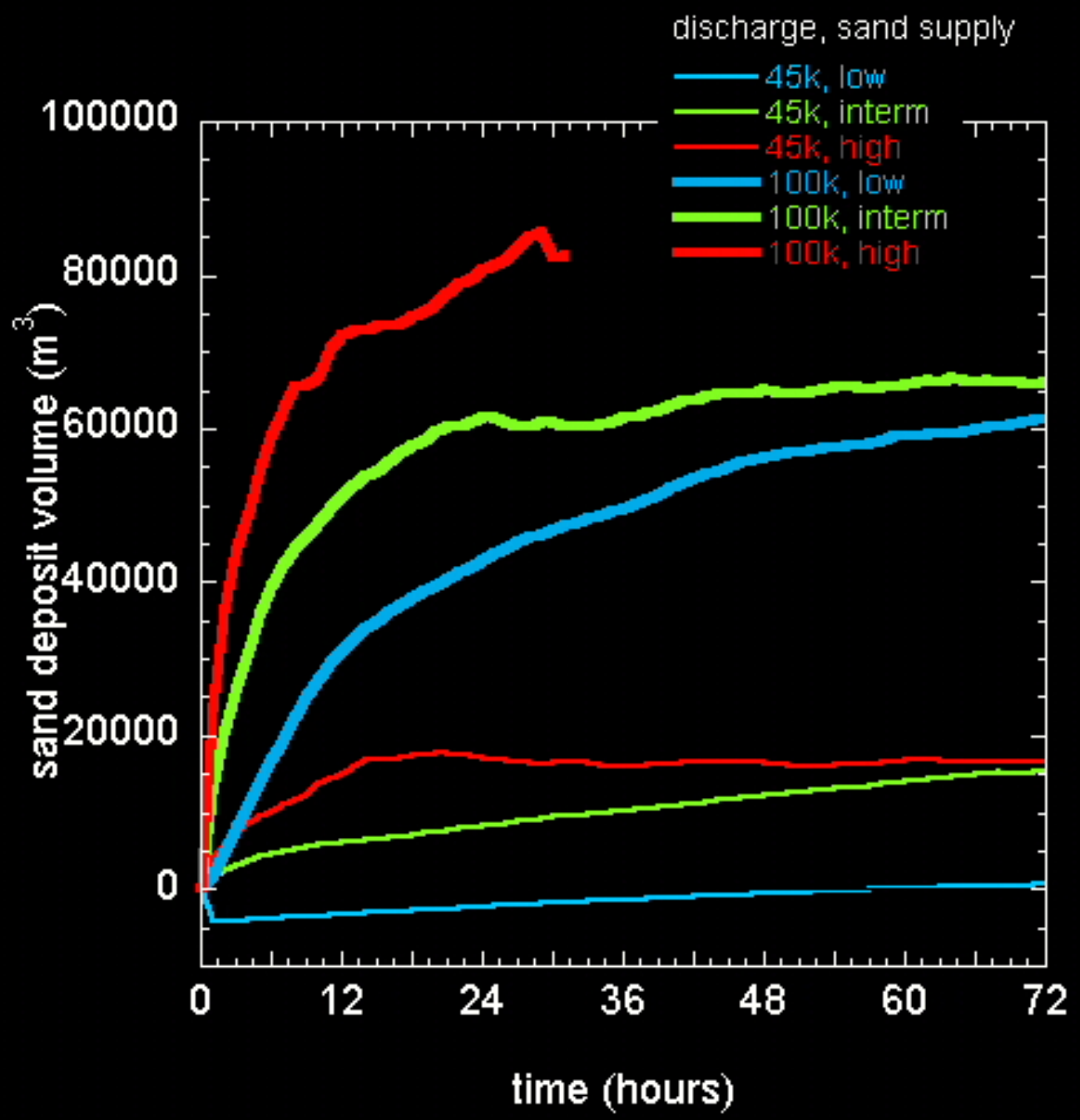
Basalt reach

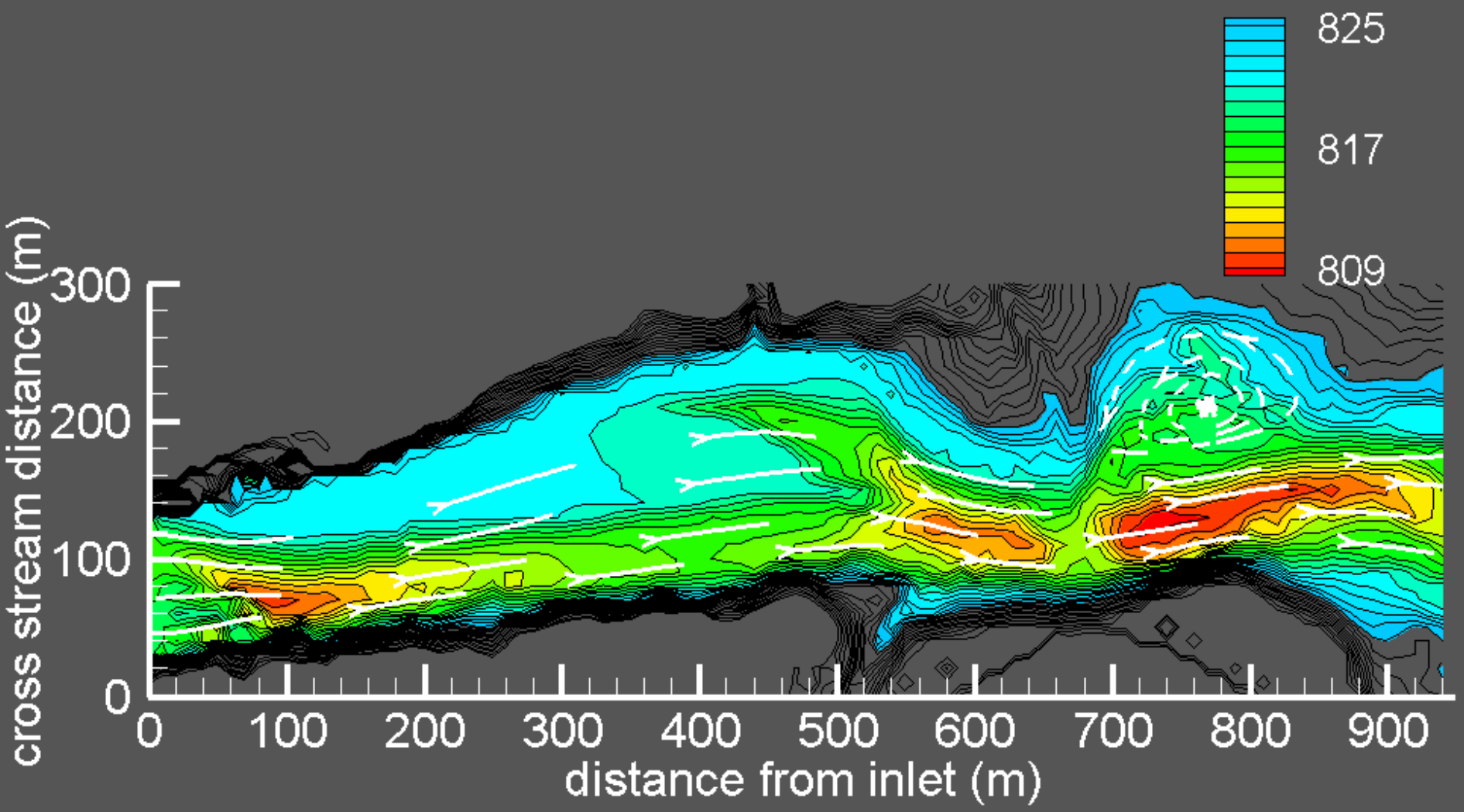
Six cases:

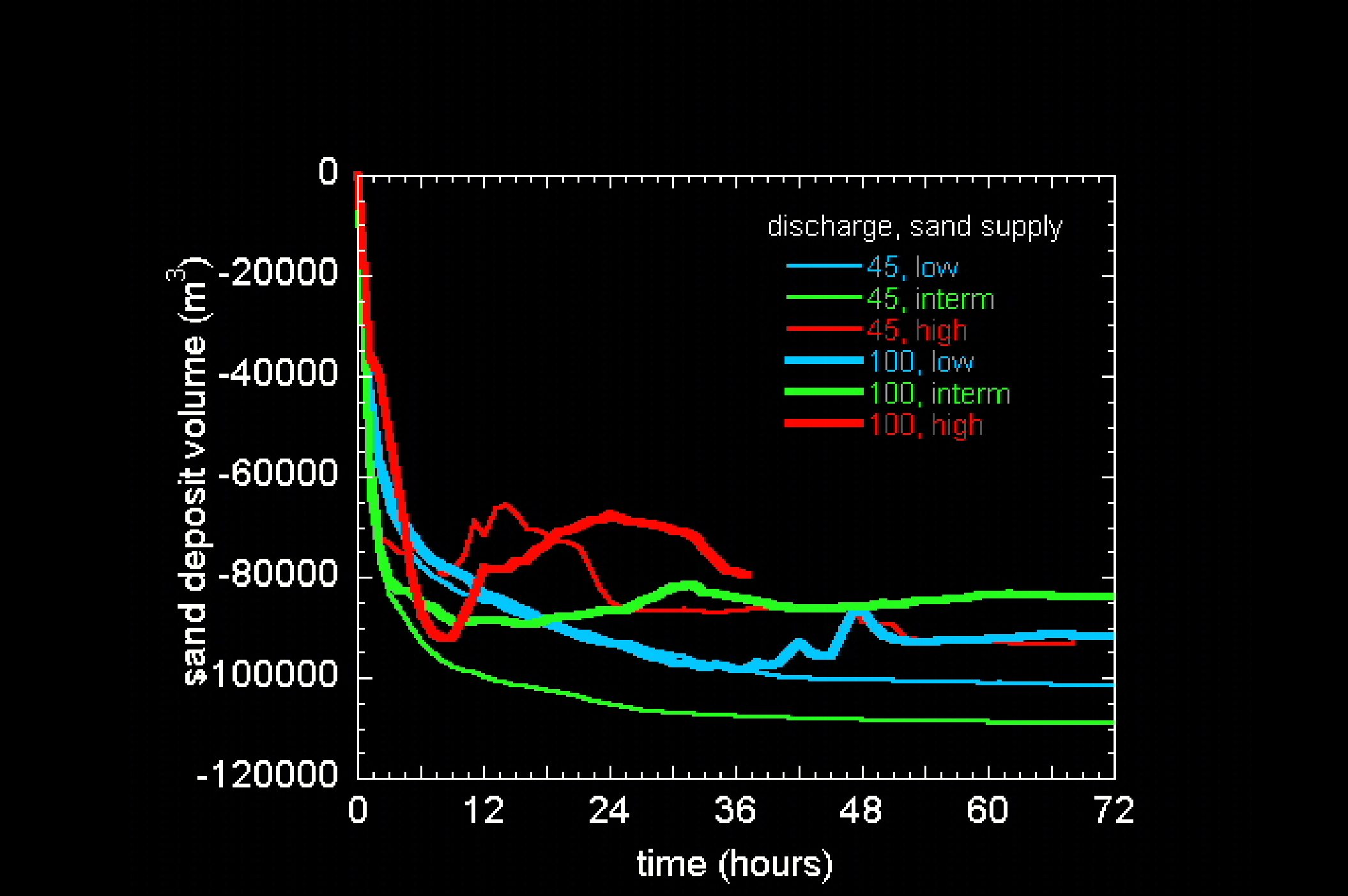
- Low, medium, and high sand supplies
- 45k and 100k cfs discharge

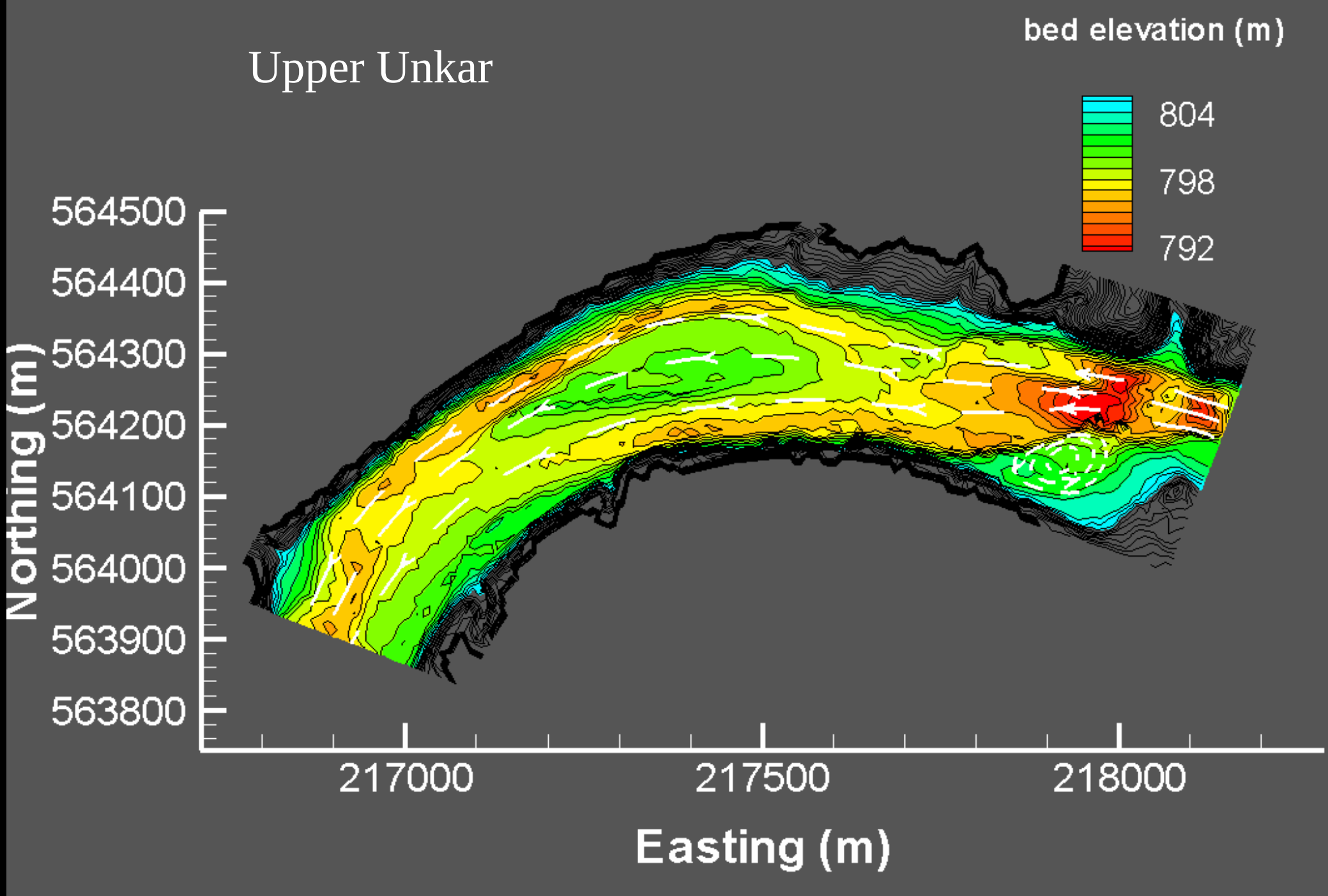

Palisades
cross stream distance (m)
300
200
100
0
0
250
500
750
distance from inlet (m)


discharge, sand supply
45k, low
45k, interm
45k, high
100k, low
100k, interm
100k, high
sand deposit volume (m3)
100000
80000
60000
40000
20000
0
0
12
24
36
48
60
72
time (hours)

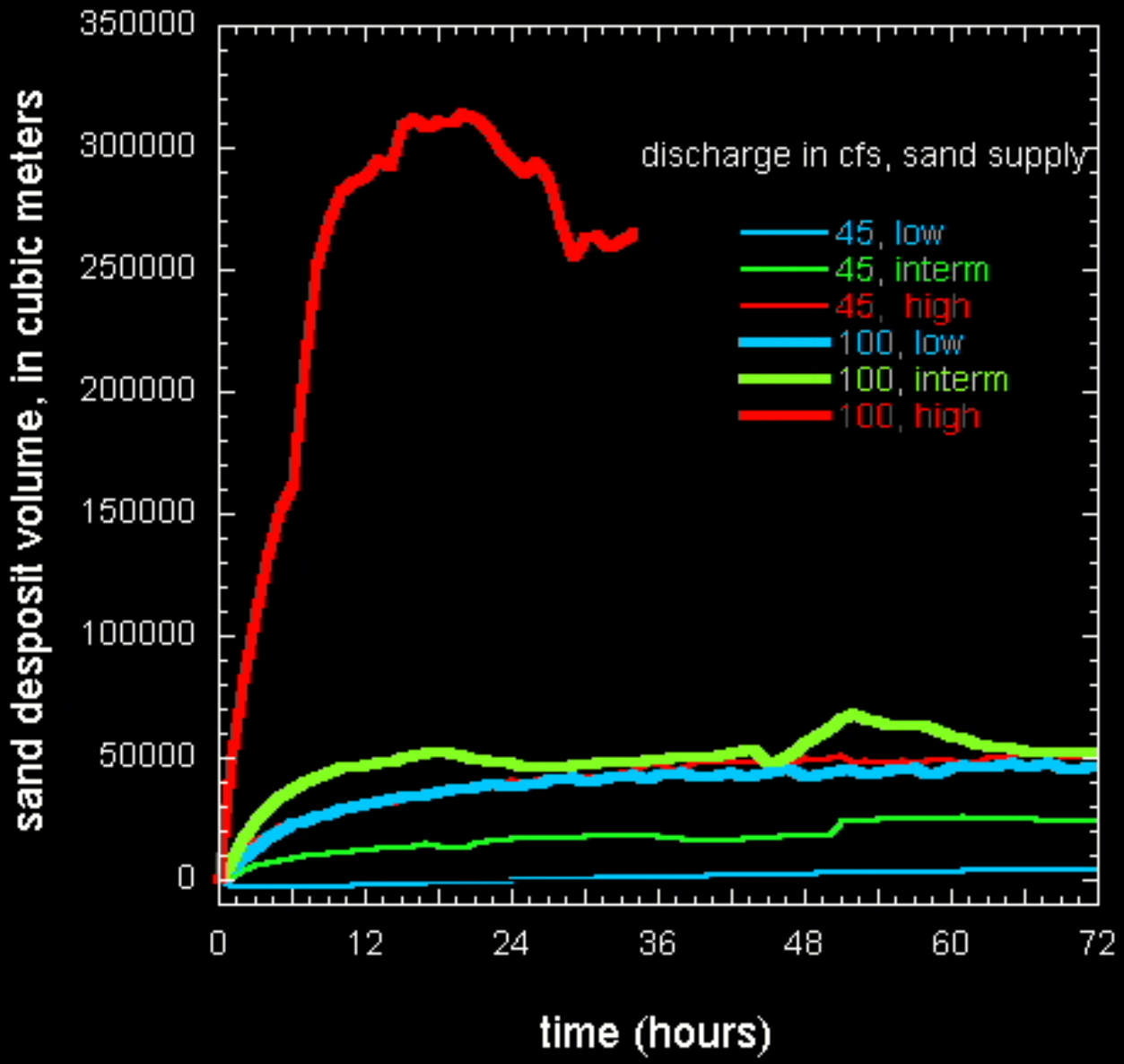
above Lava Chuar



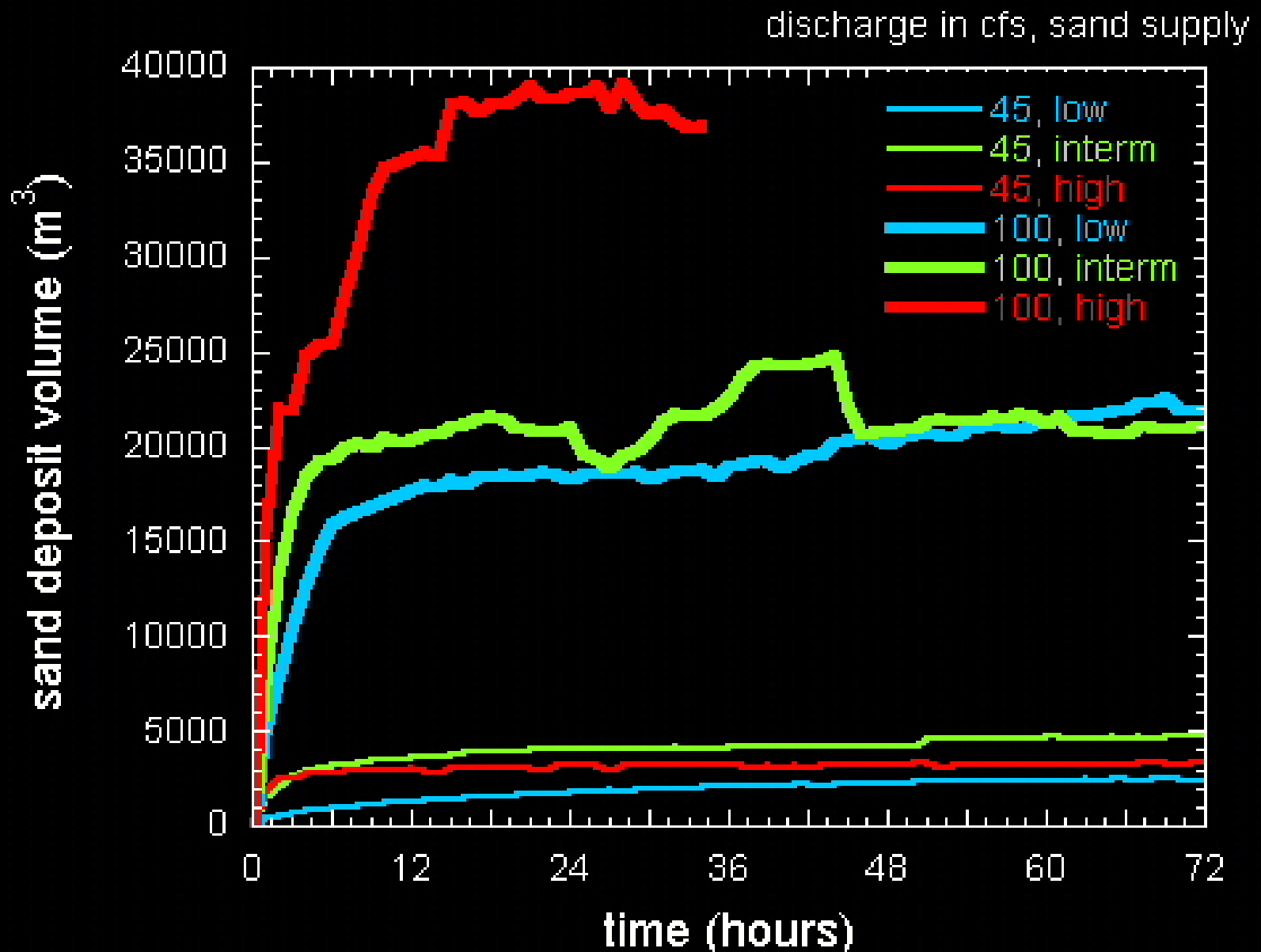

0
-20000
-40000
-60000
-80000
-100000
-120000
sand deposit volume (m3)
0
12
24
36
48
60
72
time (hours)
discharge, sand supply
45, low
45, interm
45, high
100, low
100, interm
100, high


Upper Unkar
bed elevation (m)
804
798
792
564500
564400
564300
564200
564100
564000
563900
563800
Northing (m)
217000
217500
218000
Easting (m)

Upper Unkar total sand deposition



Upper Unkar deposits above 25k cfs stage



Conclusions

- High discharge releases are more effective at generating significant deposition
- High flows are most effective during the first 2 days
- Deposition sensitive to sand supply
- Response of recirculation zones consistent; channel margins are variable